Light emission from silicon quantum dots

Researchers at the universities of **Trento** and **Catania** in Italy have demonstrated light amplification in silicon (L Pavesi *et al* 2000 *Nature* 408 440, Nov 23). Since it has an indirect bandgap, silicon is normally very inefficient at converting electrical energy into emitted light, but light amplification brings a step closer the creation of a silicon-based laser.

Silicon quantum dots were created through negative silicon ions being implanted at 80 keV into ultra-pure quartz ($1x10^{17}/cm^2$) and annealed at 1100°C for 1 hour, forming nanocrystals of about 500 silicon atoms, diameter 3 nm and density $2x10^{19}/cm^3$ centred at a depth of 110 nm from the surface (with about 35% of these designated as "surface atoms"). The quantum dots are therefore sandwiched between layers of a silicon dioxide matrix.

Excitation by optical pumping with green laser light from a doubled Ti:sapphire laser (with 390 nm light, 3ps pulse width, and 82 MHz repetition) produced amplified spontaneous emission of a much more intense beam of red light.

The net modal gain (gain minus losses) was $100\pm10cm^{-1}$. The team also carried out pump and probe (~800 nm) transmission measurements. A net material gain of $10,000\pm3000cm^{-1}$ was found.

Net optical gain was seen in both waveguide and transmission configurations. Gains per dot was orders of magnitude smaller than for direct-bandgap quantum dots, but higher stacking density of the dots brings the aggregate gains up to comparable levels.

Pavesi's team believes that the interface between the silicon nanocrystals and the oxidized silicon is responsible for the success of its device. The electronic interactions that take place at the boundary appear to create many light-emitting states.

The scientists explain the observations using a model based on population inversion of radiative states associated with the dot-matrix interface.

However, the light is incoherent. Also, since the quantum dots are created by physical isolation in an insulator (quartz) contact wires for electrical pumping are currently not yet practical. Future investigations will therefore focus on different configurations and topologies of the quantum dots.

Uniroyal's compound sales counteracting overall decline

Sales for **Uniroyal Technology Corp** (Sarasota, FL, USA) for fiscal Q1/2001 (to end-December) were US$14.3m (*down* from US$15.2m in Q1/2000). But this included sales for the Compound Semiconductor and Optoelectronics business segment (high-brightness LED manufacturer Uniroyal Optoelectronics LLC and Sterling Semiconductor Inc) which were up 90% on Q1/2000 to US$1.2m.

However, increased investment spending and the purchase of SiC manufacturer Sterling resulted in an overall loss of US$8.39m.